

JABOULAY'S ANASTOMOTIC BUTTON.¹

AN EXPERIMENTAL STUDY.

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THE purpose which I had in view when I undertook the following study was to ascertain whether the new anastomotic button, designed by Jaboulay, Professor of Surgery in Lyons, was superior to other mechanical contrivances at present employed. The opinion of the Lyons clinic was very naturally highly favorable, and Jaboulay and his assistant, Gayet, speak of the new button with unstinted praise.

At the present time surgeons are more and more of the opinion that an anastomosis made by suture is preferable to one made by any mechanical contrivance. Still, there are cases when, to save time, to prevent shock, etc., the greater safety and reliability of the suture method must give way to the use of the mechanical contrivance. Up to the present time, the only contrivance which has been universally approved of, and which has become a favorite and necessary part of every surgical equipment, is the button invented by Murphy. Jaboulay's button is to displace the button of Murphy, and in the following pages I naturally will have to compare these buttons and their relative advantages rather than enter into any comparison between the well-accepted methods of anastomosis by suture and the anastomosis that can be effected by the new button of Jaboulay.

Some years have elapsed since the new button was described. In construction it resembles superficially the button of Murphy, but its principle is quite different. Instead of introducing each half of the button through an opening in

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the bowel, proportionate to the largest diameter of the button, and then closing the incision to either side of the inner cylinder of the button by suture, *Jaboulay thought he could make use of the screw and key-ring principle and introduce the halves of his button through a very small opening, thus avoiding all use of sutures.* A button introduced in this way naturally would be placed *in situ* very much more rapidly than a Murphy button.

To understand the mechanism of the new button, I must describe its peculiarities. For purpose of description, I shall take the button of 22 millimetres diameter. As seen in the



illustration, the button consists of two halves, a male and a female. Each half is made up of two cylinders, an outer and an inner. The outer is perforated with drainage holes just as in the Murphy button, though the openings are of a different contour. At one point in the outer cylinder there is a distinct break in the continuity of this cylinder; this gap or slit is prolonged into the inner cylinder and continues almost half-way round the inner cylinder. It measures in a 22-millimetre size button approximately one-eighth the diameter of the button. It is vertical in the outer cylinder, running through its entire thickness; whereas in the inner cylinder it at first is vertical, corresponding to the slit in the outer cylinder, but very shortly bends at right angles and runs, as said above, almost half the way around the inner cylinder. In this slit the Jaboulay idea is concentrated. By means of this slit the button can be introduced into the lumen of the bowel through a small opening. Naturally, the same slit arrangement is present in the male and female halves of the button, and these

fasten into each other by means of a screw-thread arrangement somewhat similar to the mechanism of the Murphy button. As the outer cylinder has been interrupted by the slit which runs through it, to obtain approximation of the two pieces of bowel at this point when the buttons are driven home, Jaboulay had to prolong the mesial margins of the outer cylinder, *i.e.*, the margins which come into contact with each other when the buttons are approximated, otherwise there would be leakage at this point. The prolongation of this margin is in the form of a thin, elongated metal plate, which acts like a weak spring in closing the slit in the upper or mesial border of the cylinder. The extra cylinder of the Murphy button, which works on a spring and whose function is to force and hold the two apposed serosa surfaces against each other and eventually produce their necrosis, is not used in the Jaboulay button. In this button the apposition and subsequent necrosis are produced by the operator's forcing the two halves of the button very firmly together.

The technique of introducing the button as described by Gayet is as follows:

To introduce a button whose largest diameter is 22 millimetres, an incision into the bowel 1 centimetre in length is required. The half of the button held by the inner cylinder by a clamp is brought to the incision, and the lip of the slit in the outer cylinder is introduced into the lumen of the bowel by a screw motion. At first the long diameter of the outer cylinder of the button is perpendicular to the opening of the bowel, and to the surface of the bowel, gradually, however, the above diameter is made more and more nearly parallel to the surface of the bowel, and the button is screwed into place, the entire outer cylinder entering the lumen of the bowel. The button is securely held in place, primarily because the small opening in the bowel fits its inner cylinder snugly; secondarily, by the fact that the lip of the incision in the bowel prolapses into the slit which runs about half the way around the inner cylinder. After placing each half of the button *in situ*, the two parts are driven home with considerable force to make

sure there is no chance of leakage, and that the button will cut through and free itself by producing the necessary necrosis.

Jaboulay has used his button 200 times in intestinal, gastric, and gall-bladder operations. On the whole, he is very well satisfied with it. He claims that he can introduce it much more quickly than the Murphy button. Recently (*Centralblatt für Chirurgie*, 1904, p. 1195) he said that in favorable cases he can make an anastomosis in two minutes. He claims, also, that with perfect buttons the results are excellent and the procedure is perfectly safe.

Two questions naturally suggest themselves at this point. Can the button really be screwed into the bowel through a small incision? Does the button cut its way out of the anastomosis? To answer these most important questions, I undertook the following experiments after procuring six of the Jaboulay buttons from Lyons.

Before giving my results, however, let me see if we can find any answers to the above questions in the publications of Jaboulay and Gayet. Both declare that a button of the size above described can readily be introduced through a 1 centimetre incision, if the above directions are carefully followed. The gradual change in the relation between the diameter of the button and the surface of the bowel as the button is screwed into place, Gayet thinks the essential factor in introducing the button without tearing the incision. Still, if we scan carefully the incomplete reports of the few cases in his paper, we see that in Case 31 operated by Jaboulay there was a tear one-half inch long which required a suture; in Case 78 operated by Gayet there was a similar tear. How frequently the above surgeons produced tears, I cannot tell from these reports. Still, it is evident that the button, even in their hands, cannot regularly be screwed into place without tearing the bowel, and necessitating sutures.

In the fourteen anastomoses that I made in dogs I found that, though the button was easily screwed into place, I very frequently produced tears which, as far as I could see at the time of operation, involved only the serosa. In fourteen an-

astomoses I naturally used twenty-eight pieces of bowel and introduced twenty-eight halves of the buttons. In eighteen of these I tore the incision in screwing the button into place. All of these required one or more silk sutures to close the rent. In no instance, however, did the mucosa prolapse through these tears, as it does through the larger incision used in the introduction of the Murphy button.

I said above that at operation these tears apparently involved the serosa alone, but later on I shall call attention to a fact found at autopsy which forces me to conclude that the other layers of the bowel are torn more or less frequently.

These data go to show that the introduction of the Jaboulay button without producing lacerations requiring suture is by no means a regular procedure. In view of the fact that the purpose of this button is to avoid all suturing, it is evident that it does not meet the demand.

A careful examination of the button will readily explain why the introduction of the button is liable to tear the incision in the gut, for the tears, as will be seen, are actually caused by stretching and divulsion of the small incision. If the button is followed as it is screwed into the bowel, one notes that at first it screws in very readily, but as soon as half of the outer cylinder is in place a distinct resistance is encountered. The slit in the outer and inner cylinders which runs not quite half-way round the inner cylinder permits the ready introduction of the corresponding half of the outer cylinder. However, as soon as the end of the slit in the inner cylinder is reached the incision in the bowel is held fast at that point, and the incision itself is stretched to permit the outer cylinder to enter the bowel. This stretching must accommodate more than the largest diameter of the button that is still outside of the lumen. The stretching must equal in length the distance from the end of the slit in the inner cylinder around this cylinder to the tip of the spring-like plate which serves as the prolongation of the mesial surface of the outer cylinder, for the incision does not accommodate diameters; it is forced by the construction of the button to accommodate circumferences.

The distance measured from the end of the slit around the inner cylinder to the end of the plate-like prolongation on the mesial rim of the outer cylinder in a 22-millimetre button is approximately 33 millimetres. Thus the original 1 centimetre incision in the bowel is stretched to over 3 centimetres to permit the introduction of the button. This excessive stretching naturally tears the wall of the bowel and defeats in this way the very purpose of the button.

In dogs, in eighteen out of twenty-eight instances, the button's introduction produced serosa tears. Whether in the other ten cases tears were produced below the serosa I cannot say, though, judging from the behavior of the other coats of the intestine when the bowel is overstretched by distention, one might be inclined to deny tears in these cases. Jaboulay's and Gayet's cases mentioned above show that similar tears occur in the human bowel, and such was to be expected, seeing how the construction of the button has really defeated the purpose of the inventor.

Are these tears a great drawback and danger? In my cases I saw no bad result from them, though theoretically everybody will picture to himself serious possibilities, which these tears carry with them, especially when one realizes that the button may remain *in situ* indefinitely. From the few cases reported in some detail by Jaboulay and Gayet, I was unable to detect any serious results that were attributed to these tears. They had 18 per cent. mortality in their series of gastro-enterostomies for carcinoma ventriculi, and of the eighteen deaths four were due to peritonitis,—two of these were due to leakage from the button and two were due to some cause which they omitted to mention. Possibly the divulsion of the incision had some relation to some of their peritonitis cases!

From the above remark, it will be clear that the button is liable to tear the small incision, even though that is not a regular event. If the button could be regularly introduced into the human bowel without tearing the wall of the bowel, a feat which I fear is very improbable in view of the construc-

tion of the button, it would mark a decided advance over the Murphy button as far as the question of the introduction of the button is concerned; for then not only could the button be placed *in situ* more rapidly, but no sutures would be required, and the danger of soiling the peritoneum would be reduced to a minimum, for the button, while being screwed into the bowel, acts as a plug, closing the incision completely. Even as it is, despite the tears produced, the button is in some respects superior to the Murphy button, always considered from the stand-point above taken, that of the introduction of the button. In other points it is inferior to the Murphy button, and consequently, in my opinion, will never displace the older contrivance except in individual cases where greater rapidity of work is absolutely essential. It is much more quickly introduced into the bowel, and the operator is never troubled by the prolapsing mucosa which is often so annoying when the Murphy button is used. Another advantage over the Murphy button is the fact that the button is held more firmly in the incision by the walls of the gut, and the operator need not rely on sutures to grasp the button. These distinct advantages of the button are, however, outweighed by the disadvantages which will be discussed in answering the second question propounded above.

Does the button cut its way out of the anastomosis? I said above that the force that drives the Jaboulay button home is the effective element in producing the necrosis of the gut that intervenes between the outer cylinders, and thus the liberation of the button. The force used naturally must be fairly great; but even when I pressed as firmly as I could, with cotton sponges as buffers between the gut and my fingers, the button was not regularly eliminated. The pressure that was necessarily employed at times produced small hamatomata in the wall of the gut. I say necessarily, because, prior to exerting this excessive pressure, I found that, on testing the anastomosis by forcing the gastric contents through the button into the temporarily obstructed gut, an escape of gas bubbles at the anastomosis became evident. From such a leakage Jaboulay lost two patients.

In this pressure, which is necessary both to prevent leakage and to produce the necrosis prior to the passage of the button, I find one of the disadvantages of Jaboulay's button. Murphy met this difficulty by the use of the third cylinder in the male button, which works on a firm spring, obtaining both complete apposition and the necessary necrosis without use of any great pressure by the operator.

As might be expected, in view of the fact that the elimination of the Jaboulay button depends entirely on the amount of pressure exerted in driving the buttons home, the button frequently remains *in situ*, carrying with it dangers of ulceration and obstruction, etc.

In Gayet's recent paper he says, "in a very large number of the cases the button is not passed, either remaining *in situ* or falling into the stomach." (*Revue de Chirurgie*, page 474, 1904.)

Jaboulay's recent statements are less direct on this point, so that I cannot ascertain whether the button remains in the anastomosis most of the time or not. He says in one-third of the cases the button remains in the stomach. How many are free and how many firmly fixed, he does not say.

In my cases, of which twelve anastomoses were available for this purpose, eight out of the twelve buttons were passed. In these, one-third of the buttons remained in the anastomosis. Autopsy showed me why the buttons remained *in situ*. Two factors contributed to fixing the button in the anastomosis. Either insufficient tissue between the outer cylinders had been cut out by necrosis or the drainage holes had been filled with masses of thickened mucosa, which frequently ran into one such hole and out of the next one, making a loop from gastric wall to gastric wall through the button. The insufficient necrosis was occasioned by insufficient pressure, though I employed practically all the strength that I could bring to bear with thumbs and fingers of both hands. The entanglement of the mucous membrane in the drainage holes, I can explain in only one way, namely, by assuming that the mucosa was torn when the button was originally introduced, and that these

shreds of mucosa prolapsed into the drainage holes and united with one another, firmly fixing the button in its place. This peculiar behavior of the mucosa explains what I referred to above when I said that, though the tears apparently were only peritoneal, at autopsy other features showed that deeper tears, tears of the other layers of the intestine, were also produced.

From the foregoing remarks it will be apparent that the new button has the advantage of being easily and very rapidly introduced, without making a large incision in the bowel. That, on the other hand, it has the disadvantages that it divulses and tears the incision, that its halves must be driven home with great force, and that it frequently becomes firmly fixed in the anastomosis and is not eliminated.

A button to be of great use should have no such bad features, especially if it is to displace the methods of anastomosis by suture, or that by means of the Murphy button, as Gayet expects the new button to do.* I believe that Jaboulay's button will never displace these methods; in fact, never rival Murphy's button, much less the method by suture, in the general run of gastro-intestinal work.

In one class of cases, however, where its advantages are of importance and its disadvantages of little consequence, the new button may prove of great service. In advanced carcinoma cases, especially in very feeble cases of gastric cancer, the saving of time by the use of the Jaboulay button may be life prolonging, while the fact that it may not be passed is of little or no consequence. To emphasize its usefulness in this field in this type of cases, Gayet reports only 79 per cent. mortality in the last forty-one cases of gastro-enterostomy for carcinoma ventriculi. In cases where rapidity of operating is less essential, I cannot see any justification for using the new contrivance.

* Gayet says, (op. cit., p. 10,) "Terrier, Hartman, etc., have declared themselves well satisfied with the suture method, which is readily understood, seeing that they have used the buttons of Murphy and of Villard."

EXPERIMENTS.

EXPERIMENT I.—March 22, 1905. Male dog, medium size. Posterior gastroduodenostomy and anterior gastrogastrostomy. Median two-inch incision in epigastrium, stomach and duodenum drawn into the wound. Smallest button (No. 1) employed for anastomosis. Incision into stomach and duodenum about one-third diameter of the button. Button easily introduced without tears and firmly driven home. Pressure or serosa near union requiring a suture. Anastomosis completed in two and a half minutes. Then an anterior gastrogastrostomy was done with button No. 2. The incision was about one-third the size of the button's largest diameter. Introduction of button tore the serosa, requiring several sutures. Button driven firmly home. Anastomosis in three minutes. Abdominal wall closed.

April 7. Button No. 1 passed.

April 12. Autopsy. Button in gastrogastrostomy union firmly held *in situ*. Both anastomoses very firm and satisfactory.

EXPERIMENT II.—March 24, 1905. Male dog, medium size. Posterior gastroduodenostomy and anterior gastrogastrostomy. Same technique as in Experiment I. Button No. 1 in posterior gastroduodenostomy. Introduction of the button tore the serosa on the duodenum, requiring a suture. Anastomosis, without rushing, in two minutes forty seconds. Button No. 2 in gastrogastrostomy; no peritoneal tears. Anastomosis in three minutes fifteen seconds.

Neither button was passed; autopsy about three weeks later showed excellent anastomosis. Button No. 1 was free in the stomach. Button No. 2 was almost free, though attached from one-third to one-half inch of its circumference by a tongue of mucosa that held it firmly, by becoming entangled in the drainage holes.

EXPERIMENT III.—March 29, 1905. Male dog, large. Posterior gastroduodenostomy and anterior gastrogastrostomy. Same technique. Jaboulay's button No. 3. Twenty-two millimetres button used in both anastomoses. Introduction of the four halves led three times to tears which required suture. Unions were tested for leakage by forcing bowel gas, etc., through the anastomoses and obstructing exit into bowel beyond. Apparently no leakage. During operation pancreas was injured and considerable hæmorrhage ensued.

Autopsy.—Dog died within twenty hours of operation. Abdomen contained considerable blood. Here and there flakes of fibrin, especially near the gastrogastrostomy anastomosis, where the button had separated. Examination of this button later showed that the two halves could be readily drawn apart by traction. The button was defective.*

EXPERIMENT IV.—April 12, 1905. Male dog; medium size. Posterior gastroduodenostomy and entero-anastomosis. Identical technique. But-

* Jaboulay had similar experiences. The buttons can be readily tested before use by simply drawing on the two halves after they have been driven home. If the button separates, it is imperfect and not to be used.

ton size No. 2 used in posterior gastroduodenostomy; size No. 1 in the entero-anastomosis. Introduction of each half button very easily accomplished, but each and every time the serosa tore.

April 19. Button No. 1 passed.

A week or so later autopsy showed the other button *in situ*. There was no necrosis between the halves of the button. In addition, loops of mucous membrane ran through the drainage holes of the outer cylinder and firmly fixed the button.

EXPERIMENT V.—April, 1905. Male dog, medium size. Posterior gastrogastrostomy and duodeno-ileostomy. Button No. 2 used in the former, No. 1 in the latter operation. Technique similar to previous operations. Tear in stomach and tear in ileum. April 25. Button No. 1 passed.

May 10. Autopsy. Button No. 2 *in situ*. No necrosis of tissue between its halves. Mucous membrane prolapsed into drainage holes, firmly fixing button in its position.

EXPERIMENT VI.—April 26, 1905. Male dog, medium size. Posterior gastroduodenostomy and entero-anastomosis. Same technique. In both anastomoses button No. 1 used. Introduction causes two serosa tears.

May 2. Both buttons passed.

May 10. Autopsy showed excellent anastomosis.

EXPERIMENT VII.—Female dog, medium size. Posterior gastroduodenostomy and ileoduodenostomy. Same technique. Button No. 1 used in each anastomosis. Three tears produced by introduction of the three halves of the buttons. On driving the buttons home, the pressure exerted caused another serosa tear.

May 23. One button passed.

May 25. Second button passed.

Epicrisis.—In all, fourteen anastomoses were made. In no case was a reinforcing circular Lembert suture used. Perhaps such a suture might have prevented leakage in Experiment III. Jaboulay does not use a reinforcing suture, claiming it is unnecessary. If it is employed, the union is undoubtedly strengthened, and accidents, such as leakage, are prevented. Jaboulay lost two cases due to leakage. In introducing the halves of the button tears were made eighteen times. Of the fourteen buttons only eight cut their way out of the anastomosis. The eight buttons were all the smallest size button (No. 1). Why the larger buttons failed to cut their way out while the smallest size was regularly passed, I cannot understand, unless it be due to the fact that the larger the button the greater the tear in the coats of the intestine or stomach, and, as we have seen, these subserosal tears are very liable to fix the button firmly *in situ*.